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ROOST-SITE CHARACTERISTICS OF MEXICAN SPOTTED OWLS IN SIERRA FRIA, AGUASCALIENTES, MEXICO

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The Mexican Spotted Owl (*Strix occidentalis lucida*) is listed as a Threatened Species in Mexico (Anonymous 1994) and the United States (USDI 1993). In Mexico, this subspecies has been reported in the states of Chihuahua, Sonora, Durango, Jalisco, Michoacan, Guanajuato, Sinaloa, San Luis Potosí, Nuevo Leon, Coahuila (McDonald et al. 1991), Colima (Enriquez et al. 1993), and Aguascalientes (Rinkevich et al. 1995). Information on the current status and habitat use of Mexican Spotted Owls in Mexico is limited (Ganey and Dick 1995). Mexican Spotted Owls in Chihuahua, Mexico, inhabit pine-oak (Quercus spp.-*Pinus* spp.) associations in isolated forest patches in steep canyons that have moderate canopy closure (Tarango et al. 1997). They roost in pine-oak forests in canyons where live basal areas and canopy closure were higher than random plots (Young et al. 1998). Based on biomass, Mexican Spotted Owls in Chihuahua and Aguascalientes prey mainly on woodrats (*Neotoma* spp.), mice (*Peromyscus* spp., *Sigmodon hispidus*), and Eastern Cottontail Rabbits (*Sylvilagus floridanus*) (Tarango 1994, Young et al. 1997).

The U.S. Fish and Wildlife Service has developed a Recovery Plan for the Mexican Spotted Owl in the United States and Mexico (Rinkevich et al. 1995). Five recovery units have been defined for Mexico: Sierra Madre Occidental Norte, Sierra Madre Occidental Sur, Sierra Madre Oriental Norte, Sierra Madre Oriental Sur, and Eje Neovolcanico. The Sierra Madre Occidental Sur Recovery Unit includes parts of the states of Durango, Zacatecas, San Luis Potosí, Aguascalientes, Jalisco, Nayarit, Queretaro, and Guanajuato. This study presents habitat-use data of the southern-most studied population of Mexican Spotted Owls in the Sierra Madre Occidental Sur Recovery Unit in Aguascalientes.

STUDY AREA

The study was conducted in Sierra Fria, Aguascalientes, Mexico (22°05′–22°10′N, 102°35′–112°36′W). The study area encompassed 74 000 ha, and was characterized by continuous mountainous habitat with numerous valleys and canyons. Private land in the Sierra Madre Occidental Sur Recovery Unit encompassed 62%, ejidos (communal properties jointly owned by several families and designated for agricultural and livestock enterprises) 37%, and federal lands 1% of the area (Rinkevich et al. 1995). Primary human activities in the area included hunting, camping, livestock production (conducted mainly in private holdings), and farming. The rainy season begins in June and lasts through October. Average annual precipitation is 600 mm and average annual temperature is 17°C (SARH 1982).

Forested areas consisted mainly of second growth oak-pine associations. Common oak species were *Quercus eduardii, Q. potosina, Q. resinosa, Q. laeta,* and *Q. rugosa* (Rinkevich et al. 1995). Pine species included ocote (*Pinus herrerai*), nut pine (*P. cembroides*), Chihuahua pine (*P. chihuahuana*), weeping pine (*P. lumholtzii*), and Michoacan pine (*P. michoacana*) (INEGI 1981). Other dominant and codominant species were junipers (*Juniperus* spp.), manzanita (*Arctostaphylos* spp.), and madrone (*Arbutus* spp.). Grass species included *Muhlenbergia* spp. and *Sporobolus* spp. (INEGI 1981).

METHODS

Mexican Spotted Owl surveys were conducted on 18–21 May, 8–11 June, 6–9 July, 18–21 July, 11–13 August, and 9–11 September 1994. Owls were surveyed with vocal imitations from nighttime point stations. There were 27 calling stations of which 10 were overlooking canyons and 17 were along roads. Night-calling stations were

placed 0.3–0.8 km between stations in areas of continuous habitat along forest roads. Owl vocal imitation calls were directed in each of the four cardinal directions. We spent 10 min at each station calling and listening for owls. Once an owl responded at night, we estimated the distance and the direction of the responding owl with a compass. The next day, daytime call surveys were used to locate roost sites and their UTM coordinates were recorded (Forsman 1983).

We conducted habitat characterizations at roost sites in the summer of 1995 (13–15 July) in 0.04-ha circular plots (Solis and Gutierrez 1990). We evaluated plots at sites where owls and owl pellets were detected underneath roost trees, one roost tree at each site ($N = 6$). Roost trees at each site were considered the plot center. Within each plot, we recorded roost tree species, roost tree height (m) and diameter at breast height (cm), owl height above the ground (m), slope aspect, percent slope (%), number of canopy layers, canopy closure, and elevation. All tree heights were measured with a clinometer. Canopy closure was measured with a spherical densitometer as the percentage of sky obstructed by vegetation. Canopy closure was estimated at four points within the plot; each point was 5 m distant from the roost tree at a random direction and the readings were averaged. Elevation was estimated from topographic maps. Percent slope was estimated with a clinometer. Slope aspect was determined with a compass. Tree diameters were measured with a diameter tape to the nearest cm. Total percent ground cover was estimated along a 23-m line transect chosen randomly. Variables measured as ground cover were litter, woody debris, rocks, herbaceous vegetation, grass, shrubs, and bare ground (Young et al. 1998). Due to the small sample size, means and standard errors are reported; no statistical tests were run.

RESULTS

From May–September 1994, eight adults or subadults and three juveniles, consisting of four adult or subadult pairs, one juvenile pair, and a lone juvenile, were located at six roost sites. All pairs and the lone juvenile were located in oaks in multistoried oak/pine forests with two to four canopy layers. Mean roost tree height was 10.4 ± 1 1 m (±SE, $N = 6$) and mean perch height was 7.0 ± 0 7 m ($N = 6$) above ground. Mean roost tree dbh was 34.7 ± 5.3 cm (range = 17.7–49.7, $N = 6$). Mean slope was 48.9 ± 11.0 % (range = 23.5–98.9, $N = 6$) and mean canopy closure 60.7 ± 5.7 % (range = 42.5–79.0, $N = 6$) Elevations at roosting sites ranged from 2150–2800 m ($\bar{x}$ = 2540.8 ± 87.3, $N = 6$). Most owl roosts (66.6 %) were found on north-facing slopes.

Litter represented a mean of 53.7 ± 7.6 % ($N = 6$) of ground cover measured at spotted owl roost sites. Although woody debris was absent from two sites, woody debris, herbaceous vegetation, and rock cover were fairly common with means of 14.5 ± 5.3, 13.6 ± 4.7, and 14.4 ± 5.1 %, respectively ($N = 6$). Sites with low woody debris had greater proportions of rocks or forbs. All sites had low proportions of grasses ($\bar{x}$ = 3.7 ± 1.7 %, $N = 6$). Bare-ground and shrub ground cover were not detected at roost sites.

DISCUSSION

Mexican Spotted Owls in Sierra Fria roosted in oaks in multistoried oak/pine forests with two to four canopy layers. Most owls were found on north-facing slopes, similar to the findings of Tarango et al. (1997) and Young et al. (1998) in northern Mexico, Skaggs and Raitt (1988) in southern New Mexico, and Ganey and Balda (1989) in Arizona. These habitats have been suggested to provide microenvironmental conditions needed by owls during periods of high and low temperatures, and to provide protection from predators and rain and hail (Kertell 1977, Barrows 1981, Forsman et al. 1984, Dawson et al 1987, Gaines et al. 1990, Solis and Gutierrez 1990). Ganey et al. (1993) hypothesized that the Mexican Spotted Owl's inability to lose heat through evaporative cooling could explain their preference for habitats that provide cooler environments.

Because vegetation data from random plots in our study were not collected, it was not possible to determine whether vegetation in roost sites differed from vegetation in random sites. Spotted owl roost sites in southwestern Chihuahua had steeper slopes, more canopy layers, greater canopy closure, and greater live tree basal areas than random sites (Young et al. 1998). Ground cover of woody debris found at roost sites in our study resembled results reported by Tarango (1994) in northern Mexico. Also, the percent of rock as ground cover was similar to that found by Young et al. (1998) for the San Juanito-Creel area in northern Mexico.

Habitat similarities between Chihuahua and Aguascalientes could be related to the owl's prey distribution. Woodrats (*Neotoma* spp.), mice (*Peromyscus* spp.), and Eastern Cottontail Rabbits (*Sylvilagus floridanus*) comprised 82% of total prey biomass in Chihuahua and 89% of total prey biomass in Aguascalientes (Young et al 1997). Carey et al. (1992) and Ward et al. (1998) suggested that Northern Spotted Owls (*S. o. caurina*) selected habitats based on the distribution of their prey.

Tarango et al. (1997) reported that legal and illegal timber harvesting, farming, unrestricted cattle grazing, and sale of firewood by local residents were the main threats to Mexican Spotted Owls in southwestern Chihuahua. Rinkevich et al. (1995) reported similar threats to Mexican Spotted Owls in the Sierra Madre Occidental Sur Recovery Unit. However, there are several aspects of the Sierra Fria environment that are favorable to Mexican Spotted Owls, including extensive rugged forested habitats. Most importantly, Sierra Fria is a protected region where logging is prohibited. Wardens inspect all vehicles entering and leaving the area to prevent illegal timber harvesting.

Because Mexican Spotted Owls in Mexico face greater habitat threats (i.e., illegal timber harvesting and agricultural development; Tarango et al. 1997) than Mexican

Spotted Owls in the United States (Challenger 1998), forest management actions in Mexico must be focused on preserving owl habitats and strict enforcement of laws. However, management decisions must consider economic, cultural, and sociological aspects of rural communities in the process.

RESUMEN.—El Tecolote Moteado Mexicano (*Strix occidentalis lucida*) se encuentra incluido en la categoría de especie amenazada tanto en México como en los Estados Unidos. El objetivo de éste estudio fue determinar el uso de habitat por el tecolote moteado Mexicano en Sierra Fría, Aguascalientes, México. Los muestreos de tecolotes moteados fueron conducidos durante los meses de Mayo a Septiembre de 1994. Once tecolotes (tres juveniles y ocho adultos o subadultos) fueron localizados en seis situos de descanso. Los sitios dc descanso fueron caracterizados durante Julio de 1995. Los tecolotes en la Sierra Fría descanzaron en encinos (*Quercus* spp.) y en bosques con más de dos capas de vegetación en áreas con pendiente moderada a pronunciada y exposición norte con menos de 42% de porcentaje de sombreo. Se ha sugerido que un habitat con estas características ofrece condiciones micro-ambientales necesarias para esta especie de tecolote.

[Traducción de Autores]

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LITERATURE CITED

ANONYMOUS. 1994. Diario Oficial de la Federacion, NOM-059-ECOL. Secretaria de Desarrollo Social, Mexico City, D.F., Mexico.

BARROWS, C.W. 1981. Roost selection by spotted owls: an adaptation to heat stress. *Condor* 83:302–309.

CAREY, A.B., S.P. HORTON, AND B.L. BISWELL. 1992. Northern Spotted Owls: influence of prey base and landscape character. *Ecol. Monogr.* 62:223–250.

CHALLENGER, A. 1998. Utilizacion y conservacion de los ecosistemas terrestres de Mexico. Instituto de Biologia, Universite Nacional Autonoma de Mexico, Mexico, D.F., Mexico.

DAWSON, W.R., J.D. LIGON, J.R. MYERS, D. SIMBERLOFF, AND J. VERNER. 1987. Report of the scientific advisory panel on the spotted owl. *Condor* 89:205–229.

ENRIQUEZ, R.P., J.L. RANGEL, AND D.W. HOLT. 1993. Presence and distribution of Mexican owls: a review. *J Raptor Res.* 27:154–160.

FORSMAN, E.D. 1983. Methods and materials for locating and studying spotted owls. USDA For. Serv., Gen. Tech. Rep. PNW-162, Portland, OR U.S.A.

———, E.C. MESLOW, AND H.M. WIGHT. 1984. Distribution and biology of the spotted owl in Oregon. *Wildl Monogr.* 87.

GAINES, W.L., E.R. GARCIA, J.L. BUSH, AND A. SPRAGUE 1990. Results of two years of spotted owl inventories in the upper Skagit River Drainage, northwestern California. *Condor* 92:739–748.

GANEY, J.L. AND R.P. BALDA. 1989. Distribution and habitat use of Mexican Spotted Owls in Arizona. *Condor* 91:355–361.

———, R.P. BALDA, AND R.M. KING. 1993. Metabolic rate and evaporative water loss of Mexican Spotted and Great Horned Owls. *Wilson Bull.* 105:645–656.

——— AND J.L. DICK, JR. 1995. Habitat relationships of the Mexican Spotted Owl: current knowledge. Pages 1–42 *in* USDI Fish and Wildl. Serv., Mexican Spotted Owl Recovery Plan, Vol. 2. Albuquerque, NM U.S.A.

INEGI. 1981. Sintesis Geografica del Estado de Aguascalientes. Instituto Nacional de Geografia e Informatica, Aguascalientes, Mexico.

KERTELL, K. 1977. The spotted owl at Zion National Park Utah. *West. Birds* 8:147–150.

MCDONALD, C.B., J. ANDERSON, J.C. LEWIS, R. MESTA, A. RATZLAFF, T.J., TIBBITTS, AND S.O. WILLIAMS, III. 1991. Mexican Spotted Owl (*Strix occidentalis lucida*), status review. USDI Fish and Wildl. Serv., Albuquerque, NM U.S.A.

RINKEVICH, S.E., J.L. GANEY, W.H. MOIR, F.P. HOWE, F CLEMENTE, AND J.F. MARTINEZ-MONTOYA. 1995. Recovery units. Pages 36–51 *in* Mexican Spotted Owl recovery plan, Vol. 1. USDI Fish and Wildl. Serv., Albuquerque, NM U.S.A.

SARH. 1982. La cartografia aplicada al estudio del medio fisico en el estado de Aguascalientes. Plan Lerma, Secretaria de Agricultura y Recursos Hidraulicos, Guadalajara, Jalisco, Mexico.

SKAGGS, R.W. AND R.J. RAITT. 1988. A spotted owl inventory on the Lincoln National Forest, Sacramento Division. New Mexico Dept. of Game and Fish, Santa Fe, NM U.S.A.

SOLIS, D.M. AND R.J. GUTIERREZ. 1990. Summer habitat ecology of Northern Spotted Owls in northern California. *Condor* 92:739–748.

TARANGO, L.A. 1994. Mexican Spotted Owl distribution and habitat characterizations in southwestern Chihuahua, Mexico. M.S. thesis, New Mexico State Univ., Las Cruces, NM U.S.A.

———, R. VALDEZ, P.J. SWANK, AND M. CARDENAS. 1997. Mexican Spotted Owl habitat characteristics in southwestern Chihuahua, Mexico. *Southwest. Nat.* 42:132–136.

USDI. 1993. Endangered and threatened wildlife and

plants: final rule to list the Mexican Spotted Owl as threatened species. *Federal Regis.* 58:14248–14271.

WARD, J.P., JR., R.J. GUTIERREZ, AND B.R. NOON. 1998. Habitat selection by Northern Spotted Owls: the consequences of prey selection and distribution. *Condor* 100:79–92.

YOUNG, K.E., P.J. ZWANK, R. VALDEZ, J.L. DYE, AND L.A. TARANGO. 1997. Diet of Mexican Spotted Owls in Chihuahua and Aguascalientes, Mexico. *J. Raptor Res.* 31 376–380.

———, R. VALDEZ, P.J. ZWANK, AND W.R. GOULD. 1998 Density and roost site characteristics of spotted owls in the Sierra Madre Occidental, Chihuahua, Mexico *Condor* 100:732–736.

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